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Effects of Management Practices on Grassland Birds: Loggerhead Shrike

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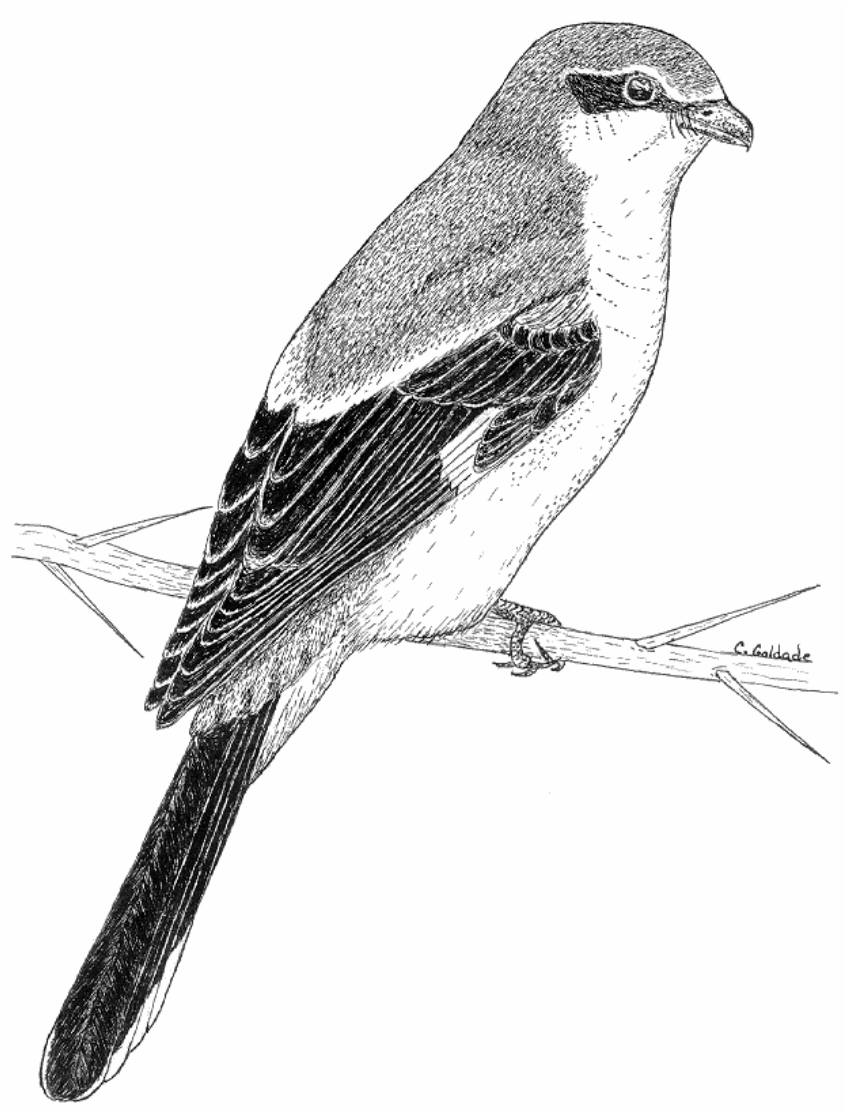
EFFECTS OF MANAGEMENT PRACTICES ON GRASSLAND BIRDS:

LOGGERHEAD SHRIKE



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This report is one in a series of literature syntheses on North American grassland birds. The need for these reports was identified by the Prairie Pothole Joint Venture (PPJV), a part of the North American Waterfowl Management Plan. The PPJV recently adopted a new goal, to stabilize or increase populations of declining grassland- and wetland-associated wildlife species in the Prairie Pothole Region. To further that objective, it is essential to understand the habitat needs of birds other than waterfowl, and how management practices affect their habitats. The focus of these reports is on management of breeding habitat, particularly in the northern Great Plains.

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Species for which syntheses are available or are in preparation:

American Bittern
Mountain Plover
Marbled Godwit
Long-billed Curlew
Willet
Wilson's Phalarope
Upland Sandpiper
Greater Prairie-Chicken
Lesser Prairie-Chicken
Northern Harrier
Swainson's Hawk
Ferruginous Hawk
Short-eared Owl
Burrowing Owl
Horned Lark
Sedge Wren
Loggerhead Shrike
Sprague's Pipit
Grasshopper Sparrow
Baird's Sparrow
Henslow's Sparrow
Le Conte's Sparrow
Nelson's Sharp-tailed Sparrow
Vesper Sparrow
Savannah Sparrow
Lark Sparrow
Field Sparrow
Clay-colored Sparrow
Chestnut-collared Longspur
McCown's Longspur
Dickcissel
Lark Bunting
Bobolink
Eastern Meadowlark
Western Meadowlark
Brown-headed Cowbird

EFFECTS OF MANAGEMENT PRACTICES ON GRASSLAND BIRDS:

LOGGERHEAD SHRIKE

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ORGANIZATION AND FEATURES OF THIS SPECIES ACCOUNT

Information on the habitat requirements and effects of habitat management on grassland birds were summarized from information in more than 4,000 published and unpublished papers. A ***range map*** is provided to indicate the relative densities of the species in North America, based on Breeding Bird Survey (BBS) data. Although birds frequently are observed outside the breeding range indicated, the maps are intended to show areas where managers might concentrate their attention. It may be ineffectual to manage habitat at a site for a species that rarely occurs in an area. The species account begins with a brief ***capsule statement***, which provides the fundamental components or keys to management for the species. A section on ***breeding range*** outlines the current breeding distribution of the species in North America, including areas that could not be mapped using BBS data. The ***suitable habitat*** section describes the breeding habitat and occasionally microhabitat characteristics of the species, especially those habitats that occur in the Great Plains. Details on habitat and microhabitat requirements often provide clues to how a species will respond to a particular management practice. A ***table*** near the end of the account complements the section on suitable habitat, and lists the specific habitat characteristics for the species by individual studies. A special section on ***prey habitat*** is included for those predatory species that have more specific prey requirements. The ***area requirements*** section provides details on territory and home range sizes, minimum area requirements, and the effects of patch size, edges, and other landscape and habitat features on abundance and productivity. It may be futile to manage a small block of suitable habitat for a species that has minimum area requirements that are larger than the area being managed. The Brown-headed Cowbird (*Molothrus ater*) is an obligate brood parasite of many grassland birds. The section on ***cowbird brood parasitism*** summarizes rates of cowbird parasitism, host responses to parasitism, and factors that influence parasitism, such as nest concealment and host density. The impact of management depends, in part, upon a species' nesting phenology and biology. The section on ***breeding-season phenology and site fidelity*** includes details on spring arrival and fall departure for migratory populations in the Great Plains, peak breeding periods, the tendency to renest after nest failure or success, and the propensity to return to a previous breeding site. The duration and timing of breeding varies among regions and years. ***Species' response to management*** summarizes the current knowledge and major findings in the literature on the effects of different management practices on the species. The section on ***management recommendations*** complements the previous section and summarizes specific recommendations for habitat management provided in the literature. If management recommendations differ in different portions of the species' breeding range, recommendations are given separately by region. The ***literature cited*** contains references to published and unpublished literature on the management effects and habitat requirements of the species. This section is not meant to be a complete bibliography; a searchable, annotated bibliography of published and unpublished papers dealing with habitat needs of grassland birds and their responses to habitat management is posted at the Web site mentioned below.

 Please direct comments and suggestions to Douglas H. Johnson, Northern Prairie Wildlife Research Center, U.S. Geological Survey, 8711 37th Street SE, Jamestown, North Dakota 58401; telephone: 701-253-5539; fax: 701-253-5553; e-mail: Douglas_H_Johnson@usgs.gov.

LOGGERHEAD SHRIKE
(*Lanius ludovicianus*)

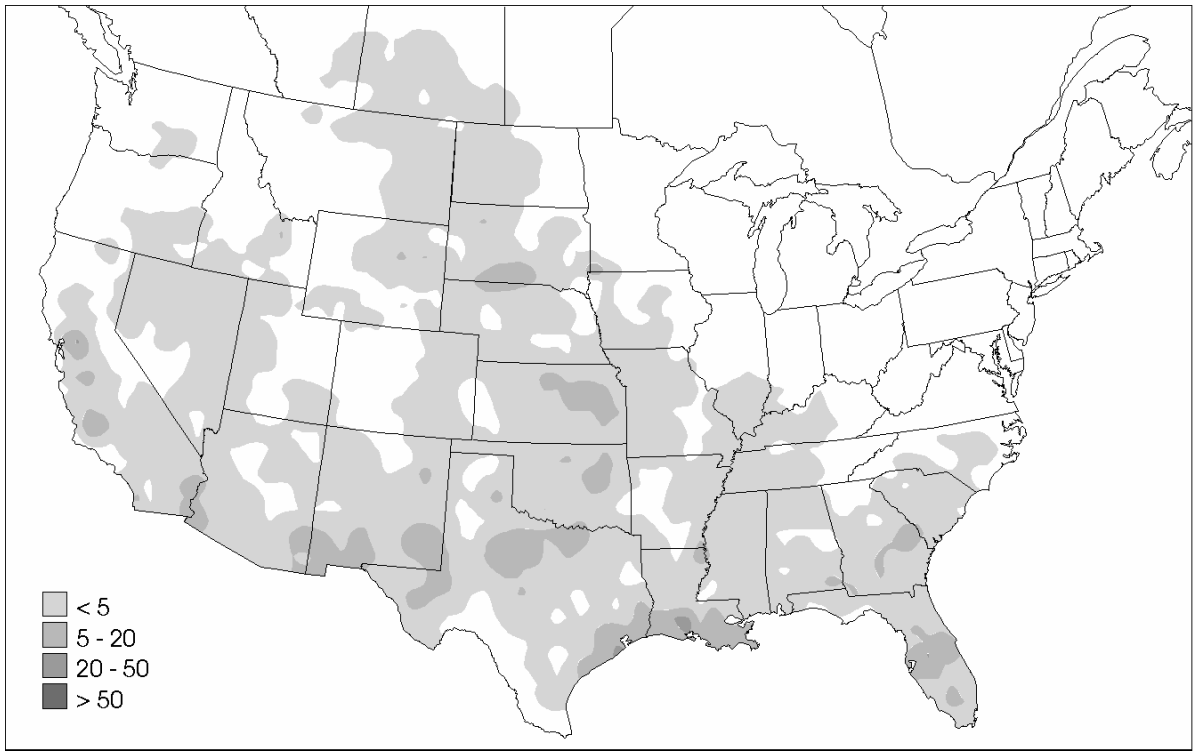

Figure. Breeding distribution of the Loggerhead Shrike in the United States and southern Canada, based on Breeding Bird Survey data, 1985-1991. Scale represents average number of individuals detected per route per year. Map from Price, J., S. Droege, and A. Price. 1995. The summer atlas of North American birds. Academic Press, London, England. 364 pages.

Key to management is providing suitable habitat, that is, grassland with scattered trees and shrubs for foraging, nesting, and perching.

Breeding range:

Loggerhead Shrikes breed from Washington, northern Alberta, central Saskatchewan, and southern Manitoba, south to California and Florida, and east to southwestern Minnesota, southern Wisconsin, southern Michigan, and Maryland (National Geographic Society 1987). (See figure for the relative densities of Loggerhead Shrike in the United States and southern Canada, based on Breeding Bird Survey data.) Loggerhead Shrikes have been reported breeding in areas north and east of the illustrated range (C. Haas, Virginia Polytechnic Institute, Blacksburg, Virginia, pers. comm.).

Suitable habitat:

Loggerhead Shrikes prefer open habitat characterized by grasses and forbs of low stature interspersed with bare ground and shrubs or low trees (Stewart 1975, Rotenberry and Wiens 1980, Brooks and Temple 1990*a*, De Geus 1990, Poole 1992, Prescott and Collister 1993, Hellman 1994, Cuddy 1995, Yosef 1996, Pruitt 2000). Loggerhead Shrikes use prairies, pastures, sagebrush (*Artemisia*) desert, and fencerows or shelterbelts of agricultural fields, as well as old orchards, riparian areas, open woodlands, farmsteads, suburban areas, mowed road

rights-of-way, abandoned railroad rights-of-way, cemeteries, golf courses, and reclaimed strip mines (Strong 1971, Stewart 1975, Poole 1992, Smith and Kruse 1992, Hellman 1994, Collister and Henry 1995, Cuddy 1995, De Geus 1990, De Geus and Best 1995, Prescott et al. 1995, Woods 1995*a*, Bjorge and Prescott 1996, Woods and Cade 1996, Yosef 1996, Pruitt 2000). Scattered shrubs or trees, particularly thick or thorny species, serve as nesting substrates and hunting perches (Porter et al. 1975, Smith 1991, Collister 1994, Chabot et al. 1995, Collister and Henry 1995, Cuddy 1995, Woods 1995*a*, Yosef 1996). Thorny shrubs or trees also serve as impaling stations. In southwest Idaho, impaling stations for prey were 7-65 m from the nest, contained one to two sharp points, and were well protected within the shrub (Woods 1995*b*). Fences, utility wires, grasses, and forbs also may be used as perches (Hellman 1994; Yosef 1996; Michaels 1997, Michaels and Cully 1998). In the upper Midwest, abundance of open habitat, foraging areas, and elevated perch sites were considered the most important factors in habitat suitability (Brooks and Temple 1990*a*).

Grasslands and structurally similar crops, such as alfalfa (*Medicago sativa*) and oat fields, are preferred over rowcrops, such as corn or soybeans (De Geus 1990, Smith 1991). In Minnesota, 45% of 48 nests were found in grassland, 37% adjacent to agricultural fields, and 18% in pastures (Brooks and Temple 1990*a*). Compared to unoccupied sites, nest sites had greater grassland and pasture cover and longer hedgerows (Brooks and Temple 1990*a*). In southwestern Iowa, nest sites were located in areas with greater tree cover and bare ground and less shrub cover than unoccupied sites, probably reflecting a preference for large nesting trees (De Geus 1990). Loggerhead Shrikes in Iowa nested in road rights-of-way composed of smooth brome (*Bromus inermus*) and small, scattered trees and shrubs (De Geus and Best 1995). Most territories in Missouri and Illinois were in pasture (Kridelbaugh 1983, Smith and Kruse 1992).

In Canada, Loggerhead Shrikes breed in pastures with isolated trees and shrubs, thickets, or hedgerows, and in thorny bushes along railroad rights-of-way (Collister and Henry 1995, Cuddy 1995). In Ontario and Quebec, Loggerhead Shrikes preferred to nest in isolated trees more so than in hedgerows; hawthorn (*Crataegus* sp.) and red cedar (*Juniperus virginiana*) were the two most common trees used for nesting (Chabot et al. 1995). In southeastern Manitoba, willow (*Salix*) shrubs growing alone or in clumps and deciduous trees growing in shelterbelts were preferred as nesting sites; these sites contained significantly more pasture, fewer trees, and longer fencerows than randomly selected sites (Hellman 1994). Nest trees in pastures had wider canopies, larger diameters, and were surrounded by fewer trees >2 m in height. Nest trees in cropland were surrounded by fewer shrubs <2 m in height (Hellman 1994). In southeastern Alberta, an average of 6.6 breeding pairs was found in seven 41.5 km^2 blocks containing >100 clusters of trees or shrubs, which was significantly higher than the average of 2.3 pairs in 12 blocks containing <50 clusters (Bjorge and Prescott 1996). Compared to random sites, areas within 400 m of shrike observations contained a greater diversity of habitats and more frequently encompassed road rights-of-way, farmyards, and shelterbelts. Compared to random sites, no differences were detected in the proportion of annually cultivated fields, pasture, or hayland in areas around shrike locations. Of 113 Loggerhead Shrike observations, 52.2% were <200 m, 6.2% were 201-400 m, and 41.6% were >400 m from roads. In another Alberta study, breeding habitat had more buffaloberry (*Shepherdia argentea*) shrubs, higher percentage of grass $\geq$20 cm tall, and taller mean height of grass and forbs than heavily grazed unoccupied habitat (Prescott and Collister 1993).

Throughout the Great Basin shrubsteppe and the Great Plains grasslands, abundance of Loggerhead Shrikes was positively correlated with percent shrub cover, percent bare ground, and

average height of emergent forb/shrub; abundance was negatively correlated with percent grass cover (Rotenberry and Wiens 1980). In Oregon and Nevada shrubsteppe, abundance of Loggerhead Shrikes was positively correlated with increasing rockiness, dead vegetation, and shrub diversity, and to the percent coverage of spiny hopsage (*Grayia spinosa*), budsage (*Artemisia spinescens*), and shortspine horsebrush (*Tetradymia spinosa*) (Wiens and Rotenberry 1981). In Washington, Loggerhead Shrike territories were located in areas characterized by relatively large, thick shrubs interspersed with native bunchgrasses or sand dune openings with about 40% bare ground (Poole 1992). Vegetation types supporting Loggerhead Shrike territories included big sagebrush (*Artemisia tridentata*) in lowland and upland areas, mixed shrub, and antelope bitterbrush (*Purshia tridentata*). In addition to having a mosaic of shrubs and openings, areas used by Loggerhead Shrikes had little slope and high horizontal and vertical structural diversity. Community types that were not dominated by shrubs, such as grasslands and riparian areas, were not used (Poole 1992).

In Idaho shrubsteppe, Loggerhead Shrikes nested in big sagebrush, antelope bitterbrush, and greasewood (*Sarcobatus vermiculatus*) (Woods 1995*a*, Woods and Cade 1996). Nests built later in the season had a tendency to be built higher above the ground and nearer to the edge of the nest shrub than earlier nests (Woods and Cade 1996). Near the Missouri River in northcentral Montana, Loggerhead Shrikes preferred nesting in limber pine (*Pinus flexilis*) and Rocky Mountain juniper (*Juniperus scopulorum*) over nesting in big sagebrush (Walcheck 1970). In Washington, shrub species more common around nest sites than unoccupied sites were live big sagebrush, antelope bitterbrush, and spiny hopsage, whereas less common species were rabbitbrush (*Chrysothamnus nauseosus*) and dead antelope bitterbrush (Poole 1992). Nest sites had greater shrub canopy, taller shrubs, and less annual grass cover than unoccupied sites. Loggerhead Shrikes preferred nesting in big sagebrush and antelope bitterbrush, and avoided spiny hopsage, rabbitbrush, and green rabbitbrush (*Chrysothamnus viscidiflorus*) (Poole 1992). Nest shrubs were taller, closer to an edge, and contained denser cover and fewer main stems than unoccupied shrubs. Roost shrubs were large, dense live shrubs, whereas tall, dead shrubs providing good visibility were used for perching (Poole 1992).

Nest success may be related to nest substrate. In central Missouri, nest success was highest in deciduous trees and lowest in multiflora rose (*Rosa multiflora*), possibly because rose bushes are not as structurally sound nor as thorny as deciduous trees used for nesting (Kridelbaugh 1983). In southcentral Washington, nests with better concealment fledged more young (Poole 1992). In Minnesota, nesting success was positively correlated with percent cover of grassland, and fledging success was positively correlated with percent cover of herbaceous vegetation and percent cover of grassland (Brooks and Temple 1990*a*). In Manitoba, nest sites with lower amounts of understory (ground cover and vegetation height) were more successful, and nests in pasture were more productive than nests in cropland or in mixed habitat types (Hellman 1994). A table near the end of the account lists the specific habitat characteristics for Loggerhead Shrikes by study.

Prey habitat:

Loggerhead Shrikes are opportunistic predators, feeding on a wide variety of small prey including insects and other arthropods, mammals, birds, reptiles, amphibians, and occasionally carrion (Sprunt 1965, Kridelbaugh 1982, Yosef 1996). Loggerhead Shrikes usually forage over areas of shorter grass (Kridelbaugh 1982, Lane and Hunt 1987), probably because prey is easier to detect in shorter vegetation. However, in Canada's shortgrass habitat, Loggerhead Shrikes

preferred to forage in the taller (≥20 cm) grass of ungrazed areas (Prescott and Collister 1993). In southeastern Alberta, foraging Loggerhead Shrikes preferred native pasture and pastures of forage crops, avoided cereal crops and native and introduced vegetation within railroad rights-of-way, and used fallow fields in proportion to their availability (Collister 1994). However, foraging success was found to be highest in railroad rights-of-way, and the tall, dense vegetation in rights-of-way may be important reserve areas for vertebrate prey during times when arthropod prey is scarce (Collister 1994). Hands et al. (1989) noted that reducing pesticide use may help protect populations of insects and other Loggerhead Shrike prey.

Area requirements:

Territories are usually about 6-9 ha in size, with average territory sizes throughout the United States ranging from 2.7 ha in Alberta (Collister 1994) to 25 ha in Idaho (Yosef 1996). In Alberta, 20 territories along a railroad right-of-way averaged 8.5 ha in size and were asymmetrical in shape (Collister 1994). Average size of 23 territories in Missouri was 4.6 ha (Kridelbaugh 1982).

Brown-headed Cowbird brood parasitism:

Little is known about the frequency of brood parasitism by Brown-headed Cowbirds (*Molothrus ater*) on Loggerhead Shrikes. Brown-headed Cowbirds may have limited opportunities to parasitize shrike nests due to the Loggerhead Shrike's aggressive and predatory nature (Potter 1939, Friedmann 1963). Only two documented cases of brood parasitism have been recorded. De Geus and Best (1991) reported that 3 of 261 nests in southwestern Iowa were parasitized. K. De Smet (Manitoba Conservation, Melita, Manitoba, *pers. comm.*) reported that 2 of 1661 nests were parasitized in Manitoba. Attempts to artificially parasitize Loggerhead Shrike nests have met with limited success (Potter 1939). Loggerhead Shrikes rejected Red-winged Blackbird (*Agelaius phoeniceus*) and Tri-colored Blackbird (*A. tricolor*) eggs that were experimentally placed in shrike nests (Rothstein 1982).

Breeding-season phenology and site fidelity:

Loggerhead Shrikes return from their wintering grounds from mid-February to early May (Porter et al. 1975, Stewart 1975, Salt and Salt 1976, Faanes 1981, Kridelbaugh 1983, Janssen 1987, Poole 1992, De Smet 1992, Tyler 1992, Collister 1994, Chabot et al. 1995, Woods 1995*b*, Michaels 1997). Fall migration stretches from about August to late October, with some stragglers leaving the breeding grounds in November (Stewart 1975, Salt and Salt 1976, Faanes 1981, Janssen 1987, Yosef 1996).

Females display low mate fidelity and have been reported to desert their first mate for a second mate (Haas and Sloane 1989). Males may display higher site fidelity than females on the breeding grounds (Kridelbaugh 1983, Haas and Sloane 1989). However, in southeastern Alberta, there was no difference in numbers of males and females that returned within 4 km of the previous year's territory (Collister 1994). Of 96 banded adults, 18 of 48 males and 13 of 48 females returned (Collister and De Smet 1997). In southwestern Manitoba, 16 of 71 males and six of 69 females returned (Collister and De Smet 1997). Mean male dispersal from one year to the next for 15 males was 0.85 km, compared to 5 km for four females. In southeastern Alberta and southwestern Manitoba combined, ten of 20 males and three of 11 females were resighted on the same territory on which they initially were banded. De Smet (1992) reported that one of 42 adults banded in Alberta returned. In Idaho, two of seven males and one of four females banded

the previous year returned to their respective breeding territories (Woods 1995*a*). In Oklahoma, a shrike was recaptured 11 years later in the same general area in which it was banded (Klimkiewicz et al. 1983). Nest sites in Ontario and Quebec were re-used in subsequent years (Chabot et al. 1995).

In Alberta, three of 249 banded nestlings returned to within 4 km of the study area (Collister and De Smet 1997). In southwestern Manitoba, 74 of 3176 banded nestlings returned (Collister and De Smet 1997). Some birds banded as nestlings did not return until 2-3 yr after banding. Also in Manitoba, of 1998 young banded, 20 returned (De Smet 1992). Nesting occurred in a range of 4-78 km from the birds' natal sites. In Idaho, four of 171 nestlings returned; three of these bred within 5 km of their natal area (Woods 1995*a*).

Loggerhead Shrikes have been known to raise two clutches in one season (Sprunt 1965, Johnsgard 1979, De Geus 1990, Poole 1992, Tyler 1992, Chabot et al. 1995, Yosef 1996) and to renest after failure of the first clutch (Porter et al. 1975, Kridelbaugh 1983, Brooks and Temple 1990*b*, Poole 1992, Hellman 1994, Chabot et al. 1995, Woods 1995*b*, Woods and Cade 1996). Loggerhead Shrikes in southeastern Alberta were not double-brooded and did not successfully renest (Collister 1994).

Species' response to management:

To maintain Loggerhead Shrike habitat, Hands et al. (1989) suggested that burning may be used to provide dense herbaceous cover and prevent woody vegetation from dominating an area, but cautioned against burning too frequently and eliminating all trees and shrubs. In northeastern Kansas, number of years since last burn, haying in the previous year, and disturbance by military activities did not appear to affect shrike's use of sites (Michaels 1997, Michaels and Cully 1998). Loggerhead Shrike abundance was not significantly different between burned and unburned tallgrass prairie within another Kansas grassland (Zimmerman 1993). Patchily burning late seral big sagebrush and antelope bitterbrush communities may provide the high horizontal and vertical structural diversity preferred by breeding Loggerhead Shrikes in shrubsteppe communities (Poole 1992).

Grazing can provide preferred habitat by shortening vegetation in taller grassland areas, such as Missouri (Kridelbaugh 1982), Illinois (Smith and Kruse 1992), and Kansas (Eddleman 1974). Trees and shrubs used for nesting and perches should be protected from cattle grazing and rubbing (Yosef 1996). In southeastern Alberta's shortgrass habitat, Loggerhead Shrikes preferred to forage in ungrazed areas, which provided taller ($\geq$20 cm) grass (Prescott and Collister 1993); however, in Missouri, 88% of all foraging attempts during the nestling stage occurred in pastures or lawns (Kridelbaugh 1982). In Alberta and Saskatchewan, Loggerhead Shrikes preferred untilled native grassland and pastures seeded with introduced grasses and legumes over cropland or fallow areas (Telfer 1992). In Alberta, Loggerhead Shrikes were found on continuously-grazed native pasture (Prescott et al. 1995). Regions with severe Loggerhead Shrike declines had lost 39% of their unimproved pasture to cropland from 1946 to 1986 and up to 79% since settlement (Telfer 1992). Areas with moderate Loggerhead Shrike declines showed lower losses of unimproved and pre-settlement pasture. In Idaho, grazing of big sagebrush areas by horses and cattle degraded several Loggerhead Shrike territories (Woods 1995*a*).

Low, thick shrubs and trees along fencerows and throughout otherwise open pastures and fields can be maintained or planted to improve nesting habitat (Kridelbaugh 1982, Hands et al. 1989, Yosef 1996). Linear habitat could possibly be improved by manipulating cover density or

adding larger blocks of habitat adjacent to strips of woody vegetation to make nests less susceptible to depredation (De Geus 1990).

Little information is available concerning the effects of pesticides on Loggerhead Shrike populations breeding in the Great Plains. However, a study on the effects of sodium ammonium nitrate fertilizer application on bahia grass (*Paspalum notatum*) pastures in central Florida suggested that Loggerhead Shrikes disappeared, died, or expanded their territories as a result of fertilizer application (Yosef and Deyrup 1998). The study suggested that fertilizer application reduced the amount of vegetation available to insects, reducing insect populations and reducing prey availability for Loggerhead Shrikes (Yosef and Deyrup 1998). In Illinois, DDE was detected in 61 of 69 shrikes (Anderson and Duzan 1978). Mean concentration of DDE was 21.89 parts per million (ppm). DDE also was detected in eggs. Mean DDE concentration in the contents of 104 eggs was 3.09 ppm. Shells of 57 eggs collected from 1971 to 1972 were 2.75% thinner than 83 museum specimens collected prior to 1900. Shell thickness was negatively correlated with DDE concentration of egg contents. In another Illinois study, 17 of 21 eggs collected from 12 nests contained average DDE levels of 0.66 ppm (Pruitt 2000). Detectable levels of DDT were found in nine eggs. No other organochlorine compounds were detected.

Management Recommendations:

Preserve native prairie in breeding and wintering areas; where this is not possible, provide seeded pastures (Hands et al. 1989, Telfer 1992). Discourage agricultural policies that encourage conversion of prairie to cropland (Hellman 1994). Preserve sagebrush/scrub habitat in the western portions of the shrike's breeding range (Woods 1995*a*, Woods and Cade 1996). Protect suitable habitat through incentive programs such as the Sodbuster Program and Conservation Reserve Program, through easements, donations, land trusts, leases, purchases, or through designation of suitable habitat as natural areas (Hands et al. 1989, Collister 1994, Hellman 1994, Collister and Henry 1995).

Provide areas of adequate size for breeding Loggerhead Shrikes, taking into consideration that females sometimes mate with more than one male or switch mates (Haas and Sloane 1989). Areas should be large enough to support several average-sized territories (about 2.7-25 ha/territory) of asymmetrical shape (Collister 1994, Yosef 1996).

Maintain low, thick shrubs and trees along fence lines, in abandoned farmyards, and throughout otherwise open pastures and fields (Kridelbaugh 1982, Hands et al. 1989, Collister 1994, Yosef 1996). Telfer (1992) recommended planting at least one small patch of willows, buffaloberry, or caragana (*Caragana* spp.) per quarter- section (64.75 ha) in fence corners or in moist areas. Hellman (1994) suggested maintaining and diversifying shelterbelts by incorporating thorny trees and bushes such as hawthorn and hedge rose (*Rosa rugosa*), and planting a 2-4 m strip of grass around shelterbelts to increase foraging areas near nest sites. As opposed to Telfer (1992), caragana was not used by shrikes for nesting (Hellman 1994). Prescott and Collister (1993) encouraged managers to evaluate the adequacy of available shrubs before planting more, but Bjorge and Prescott (1996) encouraged planting trees or shrubs in already diverse habitats to provide nesting and perching habitat. In Missouri, Kridelbaugh (1982) cautioned against planting multiflora rose because of the poor nest support offered by this shrub species; he

suggested providing thorny, native vegetation such as honey locust (*Gleditsia triacanthos*) and hawthorn instead. In southcentral Washington, Poole (1992) noted that patchily burned areas provide the high structural diversity preferred by Loggerhead Shrikes using late seral big sagebrush and antelope bitterbrush communities.

In areas with taller vegetation, implement grazing where pastures provide suitably short vegetation for Loggerhead Shrike foraging. Pastures often are preferred habitat in Missouri (Kridelbaugh 1983), Illinois (Smith and Kruse 1992), and Kansas (Eddleman 1974). Hands et al. (1989) suggested that light grazing to reduce vegetation height also may be beneficial to shrikes in the upper Midwest. Hellman (1994) suggested that moderate haying or grazing in Manitoba may increase Loggerhead Shrike productivity. However, a few areas of tall grass should be maintained within pastures as they serve as food reserves for small mammals, which are potential Loggerhead Shrike prey (Collister 1994).

In areas with naturally short vegetation, control grazing and mowing to increase areas of taller grass ($\geq$20 cm) (Prescott and Collister 1993, Collister 1994, Yosef 1996). Although Loggerhead Shrikes prefer to forage in short grass, foraging success may be higher in tall grass areas, where vertebrate prey abundance is higher (Collister 1994).

Maintain herbaceous cover, perhaps by burning at a frequency that will prevent woody vegetation from dominating the area, but not completely eliminate it (Hands et al. 1989). Yosef (1996) suggested that trimming or manual removal of shrubs and trees may be used to manage woody vegetation, in place of herbicides or frequent mowing.

Use fencing or other methods to protect old shelterbelts and nesting bushes from cattle grazing and rubbing (Collister 1994, Yosef 1996). Linear habitats may be improved by manipulating cover density, planting multiple rows of trees in shelterbelts, adding larger blocks of habitat adjacent to strips of woody vegetation, or planting thorny, native vegetation in fencerows (Kridelbaugh 1982, De Geus 1990).

Reduce use of biocides when possible to help protect insects and other prey species of the Loggerhead Shrike (Hands et al. 1989, Collister 1994, Hellman 1994).

Table. Loggerhead Shrike habitat characteristics.

Author(s)	**Location(s)**	**Habitat(s) Studied***	**Species-specific Habitat Characteristics**
Bjorge and Prescott 1996	Alberta	Cropland, hayland, idle, idle tame, mixed-grass pasture, woodland	Number of breeding pairs was significantly higher (6.6 pairs vs. 2.3 pairs) in seven 41.5 km^2 blocks containing >100 clusters of trees or shrubs than in 12 blocks containing <50 clusters; compared to random sites, areas within 400 m of shrike observations contained a greater diversity of habitats and more frequently encompassed road rights-of-way, farmyards, and shelterbelts; compared to random sites, no differences were detected in the proportion of annually cultivated fields, pasture, or hayland in areas around shrike locations; of 113 Loggerhead Shrike observations, 52.2% were <200 m, 6.2% were 201-400 m, and 41.6% were >400 m from roads
Brooks and Temple 1990*a*	Minnesota	Cropland, hayland, pasture, tallgrass	Nested most frequently in red cedar (*Juniperus virginiana*), deciduous trees bearing thorns or spines, and spruce (*Picea* spp.) trees, about 1.7-9.2 m tall; occupied sites with a higher percentage of grassland and higher combined pasture and grassland cover than unoccupied sites
Chabot et al. 1995	Ontario, Quebec	Not given	Preferred to nest in isolated trees such as hawthorn (*Crataegus*) and red cedar more so than in hedgerows
Collister 1994	Alberta	Cropland, idle, idle mixed-grass, idle tame, mixed-grass pasture, tame pasture	Preferred to nest in buffaloberry (*Shepherdia argentea*); habitat within territories averaged about 52% native pasture, 33% right-of-way, 8% tame pasture (forage crops), 5% fallow, and 2% cropland
Collister and Henry	Alberta	Idle mixed-grass	Nested in buffaloberry along railroad rights-of-way

1995			
Cuddy 1995	Ontario	Pasture	Bred in pastures with low grass cover, scattered trees, hawthorn and red cedar shrubs, thickets, and hedgerows
De Geus 1990	Iowa	Cropland, idle tame, tame hayland, tame pasture	Nested in white mulberry (*Morus alba*) and other low trees and shrubs; mean height of trees/shrubs used for nesting was 5.8 m; nest sites had more bare ground and tree coverage and less shrub coverage than random sites; selected areas with more grassland, which included bluegrass (*Poa*) pasture, idle cropland, alfalfa (*Medicago sativa*), and oats; avoided rowcrops (corn and soybeans)
De Geus and Best 1995	Iowa	Idle tame	Commonly nested in road rights-of-way composed of smooth brome (*Bromus inermus*) and small, scattered trees and shrubs
Eddleman 1974	Kansas	Burned tallgrass, burned tallgrass pasture, idle tallgrass, tallgrass pasture	Preferred moderately grazed areas
Hellman 1994	Manitoba	Aspen parkland, cropland, mixed-grass pasture, tame hayland	Preferred areas dominated by mixed-grass pasture and territories with long fences; majority of nests were built in either willow (*Salix*) shrubs or in deciduous trees of shelterbelts; preferred nest sites with low amounts of understory (ground cover and vegetation height). Nest trees in pasture had wider canopies, larger diameters, and were surrounded by fewer trees >2 m; nest trees in cropland were more alive and were surrounded by fewer shrubs <2 m in height. Nest sites with low amounts of understory had highest nest success
Kridelbaugh 1982, 1983	Missouri	Cropland, hayland, idle, pasture	Nested in red cedar, multiflora rose (*Rosa multiflora*), honey locust (*Gleditsia triacanthos*), and osage orange

			(*Maclura pomifera*); on average, 62% of nests occurred along fencerows or hedgerows; habitat surrounding nests was 67% pasture, 20% oldfields, 6% urban areas, 5% hayfields, and 2% wheat fields
Lane and Hunt 1987	Illinois	Not given	Highest nest success was in nests >3 m high in conifers, $\leq$100 m from buildings, utility lines, and impaling sites, and in areas with $\geq$50% short grass cover
Michaels 1997, Michaels and Cully 1998	Kansas	Burned tallgrass, idle tallgrass, tallgrass hayland	Preferred savanna over grassland or woodland edge; nested in red cedar, red mulberry (*Morus rubra*), and osage orange; used sites characterized by high structural heterogeneity, deep litter, high cover of bare ground and standing dead vegetation, high maximum vegetation height, and low total vegetative cover
Poole 1992	Washington	Burned shrubsteppe, idle shrubsteppe	Preferred flat areas of relatively large, thick shrubs with high structural diversity interspersed with native bunchgrasses or sand dune openings with about 40% bare ground; nest sites had greater shrub canopy cover (median value for canopy cover of nest sites was 5.9%), taller shrubs (average of 121.1 cm for live shrubs and 60 cm for dead shrubs), and less annual grass cover (average of 12.6%) than unoccupied sites; shrub species more common around nest sites than unoccupied sites were live big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata),* and spiny hopsage (*Grayia spinosa*), whereas less common species were rabbitbrush (*Chrysothamnus nauseosus*) and dead antelope bitterbrush; nest shrubs were taller (average of 178.5 cm), had fewer main stems (median of 5.0 stems), contain denser cover for concealing nests, and were closer to an edge (median of 3 m) than unoccupied shrubs; preferred big sagebrush and antelope bitterbrush

			as nest substrates, avoided spiny hopsage, rabbitbrush, and green rabbitbrush (*Chrysothamnus viscidiflorus*); roosted in large, dense, live shrubs and perched in tall, dead shrubs with good visibility
Porter et al. 1975	Colorado	Idle shortgrass	Cover and thorns provided by nest tree appeared to be more important than tree species
Prescott and Collister 1993	Alberta	Cropland, hayland, idle, tame hayland, mixed-grass	Used shrubby areas interspersed with grass and forbs; often nested in thorny buffaloberry ≥1.8 m tall; occupied sites had a greater percentage of tall (≥20 cm) grass (24.1% vs. 2.5%) and higher mean grass height (20.0 cm vs. 15.8 cm) than unoccupied sites
Prescott et al. 1995	Alberta	Cropland, dense nesting cover (DNC; idle seeded-native, idle tame), idle mixed-grass, idle parkland, idle tame, mixed-grass pasture, parkland pasture, tame hayland, tame pasture, wetland, woodland	Occurred only in continuously-grazed native grassland
Rotenberry and Wiens 1980	Colorado, Kansas, Montana, Nebraska, Oklahoma, Oregon, South Dakota, Texas, Washington, Wisconsin, Wyoming	Idle mixed-grass, idle shortgrass, idle shrubsteppe, idle tallgrass, montane meadow	Abundance was positively correlated with percent shrub cover, percent bare ground, and average height of emergent forb/shrub; abundance was negatively correlated with percent grass cover

Smith 1991, Smith and Kruse 1992	Illinois	Cropland, hayland, idle, pasture	Were most frequent in ungrazed pasture, hedgerows, corn fields, yards; preferred pastures, hay meadow/small-grain fields, and winter wheat fields; did not prefer rowcrops or woodlands (were observed near these habitats, but used them much less than expected by chance). Nested in a wide variety of different tree and shrub species
Sprunt 1965	Great Plains	Idle shortgrass	Nested in cottonwoods (*Populus*) and willows along waterways; preferred open grassland with wet areas in lowlands, and cottonwoods in uplands
Stewart 1975	North Dakota	Cropland, idle mixed-grass	Used edges of open country, including cropland and native prairie; used both natural and human-made areas with thickets of low trees and shrubs, including shelterbelts, cemeteries, and farmsteads
Strong 1971	Colorado	Idle, shortgrass pasture	Nested in trees and shrubs of roadsides, farmsteads, shelterbelts, and stream bottoms
Telfer 1992	Alberta, Saskatchewan	Cropland, shortgrass pasture, tame pasture	Preferred native grassland and land seeded with introduced grasses and legumes; used open areas with short grass and some trees
Tyler 1992	Oklahoma	Cropland, hayland, pasture	Nested in woody plants <6 m tall, including osage orange, netleaf hackberry (*Celtis reticulata*), Siberian elm (*Ulmus pumila*), and red cedar
Walcheck 1970	Montana	Shrubsteppe, woodland	Preferred nesting in limber pine (*Pinus flexilis*) and Rocky Mountain juniper (*Juniperus scopulorum*) over nesting in big sagebrush
Wiens and Rotenberry	Nevada,	Idle shrubsteppe	Abundance was positively correlated to increasing rockiness, dead vegetation, and shrub diversity, and to

1981	Oregon		the percent coverage of spiny hopsage, budsage (*Artemisia spinescens*), and shortspine horsebrush (*Tetradymia spinosa*)
Woods 1995*a*,*b*	Idaho	Idle shrubsteppe	Nested in big sagebrush and antelope bitterbrush and used impaling stations that were 7-65 m from the nest, contained one to two sharp points, and were well protected within the shrub
Woods and Cade 1996	Idaho	Idle shrubsteppe	Nested in big sagebrush, greasewood (Sarcobatus vermiculatus), and antelope bitterbrush

*In an effort to standardize terminology among studies, various descriptors were used to denote the management or type of habitat. "Idle" used as a modifier (e.g., idle tallgrass) denotes undisturbed or unmanaged (e.g., not burned, mowed, or grazed) areas. "Idle" by itself denotes unmanaged areas in which the plant species were not mentioned. Examples of "idle" habitats include weedy or fallow areas (e.g., oldfields), fencerows, grassed waterways, terraces, ditches, and road rights-of-way. "Tame" denotes introduced plant species (e.g., smooth brome [*Bromus inermis*]) that are not native to North American prairies. "Hayland" refers to any habitat that was mowed, regardless of whether the resulting cut vegetation was removed. "Burned" includes habitats that were burned intentionally or accidentally or those burned by natural forces (e.g., lightning). In situations where there are two or more descriptors (e.g., idle tame hayland), the first descriptor modifies the following descriptors. For example, idle tame hayland is habitat that is usually mowed annually but happened to be undisturbed during the year of the study.

LITERATURE CITED

Anderson, W. L., and R. E. Duzan. 1978. DDE residues and eggshell thinning in Loggerhead Shrikes. Wilson Bulletin 90:215-220.

Bjorge, R. R., and D.R.C. Prescott. 1996. Population estimate and habitat associations of the Loggerhead Shrike, *Lanius ludovicianus*, in southeastern Alberta. Canadian Field-Naturalist 445-449.

Brooks, B. L., and S. A. Temple. 1990*a*. Habitat availability and suitability for Loggerhead Shrikes in the upper Midwest. American Midland Naturalist 123:75-83.

Brooks, B. L., and S. A. Temple. 1990*b*. Dynamics of a Loggerhead Shrike population in Minnesota. Wilson Bulletin 102:441-450.

Chabot, A., R. D. Titman, and D. D. Bird. 1995. Habitat selection and breeding biology of Loggerhead Shrikes in eastern Ontario and Quebec. Pages 155-156 *in* R. Yosef and F. E. Lohrer, editors. Shrikes (Laniidae) of the world: biology and conservation. Proceedings of the Western Foundation of Vertebrate Zoology, volume 6.

Collister, D. M. 1994. Breeding ecology and habitat preservation of the Loggerhead Shrike in southeastern Alberta. M.S. thesis. University of Calgary, Calgary, Alberta. 161 pages.

Collister, D. M., and K. De Smet. 1997. Breeding and natal dispersal in the Loggerhead Shrike. Journal of Field Ornithology 68:273-282.

Collister, D. M., and J. D. Henry. 1995. Preservation of Loggerhead Shrike (*Lanius ludovicianus*) habitat in southeastern Alberta. Pages 280-282 *in* R. Yosef and F. E. Lohrer, editors. Shrikes (Laniidae) of the world: biology and conservation. Proceedings of the Western Foundation of Vertebrate Zoology, volume 6.

Cuddy, D. 1995. Protection and restoration of breeding habitat for the loggerhead shrike (*Lanius ludovicianus*) in Ontario, Canada. Pages 283-286 *in* R. Yosef and F. E. Lohrer, editors. Shrikes (Laniidae) of the world: biology and conservation. Proceedings of the Western Foundation of Vertebrate Zoology, volume 6.

De Geus, D. W. 1990. Productivity and habitat preferences of Loggerhead Shrikes inhabiting roadsides in a midwestern agroenvironment. M.S. thesis. Iowa State University, Ames, Iowa. 51 pages.

De Geus, D. W., and L. B. Best. 1991. Brown-headed Cowbirds parasitize Loggerhead Shrikes: first records for family Laniidae. Wilson Bulletin 103:504-505.

De Geus, D. W., and L. B. Best. 1995. A survey of Loggerhead Shrike (*Lanius ludovicianus*) breeding pairs in Adair County roadsides. Iowa Bird Life 65:1-4.

De Smet, K. D. 1992. Manitoba's threatened and endangered grassland birds: 1991 update and five-year summary. Manuscript report 92-03, Manitoba Natural Resources, Winnipeg, Manitoba. 77 pages.

Eddleman, W. R. 1974. The effects of burning and grazing on bird populations in native prairie in the Kansas Flint Hills. Unpublished report, National Science Foundation-Undergraduate Research Program. Kansas State University, Manhattan, Kansas. 33 pages.

Faanes, C. A. 1981. Birds of the St. Croix River Valley: Minnesota and Wisconsin. U.S. Fish and Wildlife Service, Washington, D.C. North American Fauna 73. 196 pages.

Friedmann, H. 1963. Host relations of the parasitic cowbirds. U.S. National Museum Bulletin 233:1-276.

Haas, C. A., and S. A. Sloane. 1989. Low return rates of migratory Loggerhead Shrikes: winter mortality or low site fidelity? Wilson Bulletin 101:458-460.

Hands, H. M., R. D. Drobney, and M. R. Ryan. 1989. Status of the Loggerhead Shrike in the northcentral United States. U.S. Fish and Wildlife Service Cooperative Fish and Wildlife Research Unit, Columbia, Missouri. Prepared for: U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 15 pages.

Hellman, S. L. 1994. Breeding habitat for the Loggerhead Shrike (*Lanius ludovicianus*) in southwestern Manitoba. M.S. thesis. University of Manitoba, Winnipeg, Manitoba. 96 pages.

Janssen, R. B. 1987. Birds in Minnesota. University of Minnesota Press, Minneapolis, Minnesota. 352 pages.

Johnsgard, P. A. 1979. Birds of the Great Plains. University of Nebraska Press, Lincoln, Nebraska. 539 pages.

Klimkiewicz, M. K., R. B. Clapp, and A. G. Futcher. 1983. Longevity records of North American birds: remizidae through parulinae. Journal of Field Ornithology 54:287-294.

Kridelbaugh, A. L. 1982. An ecological study of Loggerhead Shrikes in central Missouri. M.S. thesis. University of Missouri, Columbia, Missouri. 114 pages.

Kridelbaugh, A. L. 1983. Nesting ecology of the Loggerhead Shrike in central Missouri. Wilson Bulletin 95:303-308.

Lane, B. E., and L. B. Hunt. 1987. Nesting requirements of Loggerhead Shrikes (*Lanius ludovicianus*) in southcentral Illinois. Transactions of the Illinois State Academy of Science 80:51.

Michaels, H. L. 1997. Landscape and fine scale habitat associations of the Loggerhead Shrike and Henslow's Sparrow on Fort Riley Military Installation, Kansas. M.S. thesis. Kansas State University, Manhattan, Kansas. 109 pages.

Michaels, H. L., and J. F. Cully, Jr. 1998. Landscape and fine scale habitat associations of the Loggerhead Shrike. Wilson Bulletin 110:474-482.

National Geographic Society. 1987. Field guide to the birds of North America, second edition. National Geographic Society, Washington, D.C. 464 pages.

Poole, L. D. 1992. Reproductive success and nesting habitat of Loggerhead Shrikes in shrubsteppe communities. M. S. thesis. Oregon State University, Corvallis, Oregon. 69 pages.

Porter, D. K., M. A. Strong, J. B. Giezentanner, and R. A. Ryder. 1975. Nest ecology, productivity, and growth of the Loggerhead Shrike on the shortgrass prairie. Southwestern Naturalist 19:429-436.

Potter, L. B. 1939. Shrikes, red-wings, and the cowbird. Condor 41:219-220.

Prescott, D. R. C., and D. M. Collister. 1993. Characteristics of occupied and unoccupied Loggerhead Shrike territories in southeastern Alberta. Journal of Wildlife Management 57:346-352.

Prescott, D. R. C., A. J. Murphy, and E. Ewaschuk. 1995. An avian community approach to determining biodiversity values of NAWMP habitats in the Aspen Parkland of Alberta. NAWMP-012. Alberta NAWMP Centre, Edmonton, Alberta. 58 pages.

Pruitt, L. 2000. Loggerhead Shrike. Status Assessment, U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 169 pages.

Rotenberry, J. T., and J. A. Wiens. 1980. Habitat structure, patchiness, and avian communities in North American steppe vegetation: a multivariate analysis. Ecology 61:1228-1250.

Rothstein, S. I. 1982. Successes and failures in avian egg and nestling recognition with comments on the utility of optimality reasoning. American Zoologist 22:547-560.

Salt, W. R., and J. R. Salt. 1976. The birds of Alberta. Hurtig Publishers, Edmonton, Alberta. 498 pages.

Smith, E. L. 1991. Factors influencing distribution and abundance of the Loggerhead Shrike (*Lanius ludovicianus migrans*) in southcentral Illinois. M.S. thesis. Eastern Illinois University, 45 pages.

Smith, E. L., and K. C. Kruse. 1992. The relationship between land-use and the distribution and abundance of Loggerhead Shrikes in south-central Illinois. Journal of Field Ornithology 63:420-427.

Sprunt, A., Jr. 1965. Loggerhead Shrike. Pages 131-148 *in* A. C. Bent, editor. Life histories of North American wagtails, shrikes, vireos, and their allies. Dover Publications, Inc., New York, New York.

Stewart, R. E. 1975. Breeding birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, North Dakota. 295 pages.

Strong, M. A. 1971. Avian productivity on the shortgrass prairie of northcentral Colorado. M.S. thesis. Colorado State University, Fort Collins, Colorado. 70 pages.

Telfer, E. S. 1992. Habitat change as a factor in the decline of the western Canadian Loggerhead Shrike, *Lanius ludovicianus*, population. Canadian Field-Naturalist 106:321-326.

Tyler, J. D. 1992. Nesting ecology of the Loggerhead Shrike in southwestern Oklahoma. Wilson Bulletin 104:95-104.

Walcheck, K. C. 1970. Nesting bird ecology of four plant communities in the Missouri River breaks, Montana. Wilson Bulletin 82:370-382.

Wiens, J. A., and J. T. Rotenberry. 1981. Habitat associations and community structure in shrubsteppe environments. Ecological Monographs 51:21-41.

Woods, C. P. 1995*a*. Status of Loggerhead Shrikes in the sagebrush habitat of southwestern Idaho. Pages 150-154 *in* R. Yosef and F. E. Lohrer, editors. Shrikes (Laniidae) of the world: biology and conservation. Proceedings of the Western Foundation of Vertebrate Zoology, volume 6.

Woods, C. P. 1995*b*. Breeding ecology of *Lanius ludovicianus* nesting in sagebrush. Pages 244-250 *in* R. Yosef and F. E. Lohrer, editors. Shrikes (Laniidae) of the world: biology and conservation. Proceedings of the Western Foundation of Vertebrate Zoology, volume 6.

Woods, C. P., and T. J. Cade. 1996. Nesting habits of the Loggerhead Shrike in sagebrush. Condor 98:75-81.

Yosef, R. 1996. Loggerhead Shrike (*Lanius ludovicianus*). *In* A. Poole and F. Gill, editors. The birds of North America, No. 231. The Academy of Natural Sciences, Philadelphia, Pennsylvania; The American Ornithologists' Union, Washington, D.C.

Yosef, R., and M. A. Deyrup. 1998. Effects of fertilizer-induced reduction of invertebrates on reproductive success of Loggerhead Shrikes (*Lanius ludovicianus*). Journal of Field Ornithology 139:307-312.

Zimmerman, J. L. 1993. Birds of Konza: the avian ecology of the tallgrass prairie. University of Kansas Press, Lawrence, Kansas. 186 pages.